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AIR WAR COLLEGE

RESEARCH REPORT

AIR INTERDICTION: A FRESH LOOK

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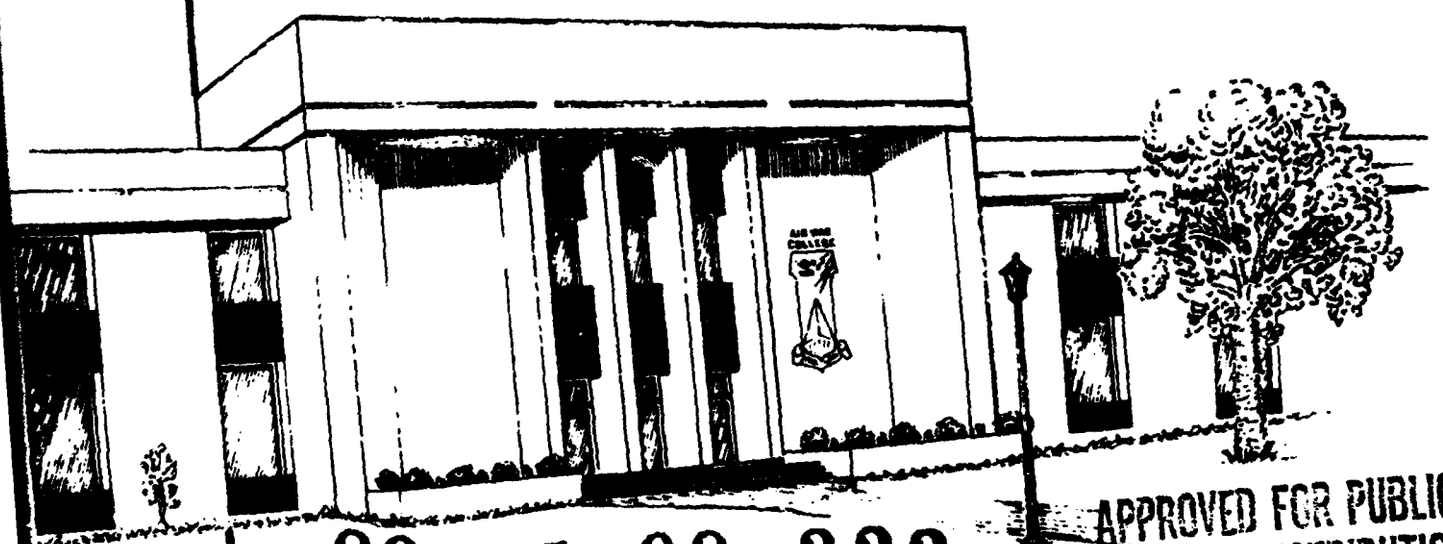

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AIR WAR COLLEGE
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AIR INTERDICTION: A FRESH LOOK

by

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A RESEARCH REPORT SUBMITTED TO THE FACULTY

IN

FULFILLMENT OF THE RESEARCH

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MAXWELL AIR FORCE BASE, ALABAMA

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AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: Air Interdiction: A Fresh Look

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The study begins with some introductory remarks about the air interdiction mission which are followed by a historical review of air interdiction, focusing on lessons learned and mistakes made. From these historical bases, the basic theories of air interdiction campaigns are developed. These theories are then applied against the Soviet doctrine for ground warfare, and some strategies are developed for the use of air interdiction against Soviet or Soviet-style ground forces. The report concludes by identifying the shortcomings of previous interdiction planners, enumerating the axioms of interdiction theory and recommending some new hardware acquisition and thought processes.

BIOGRAPHICAL SKETCH

Lieutenant Colonel Donald F. Hayes, (M.S. University of New Mexico), is a command pilot with over 2000 hours of fightertime. He served a combat tour as an F-4 pilot at Korat AB, Thailand, and commanded the 36 TFS at Osan AB, Republic of Korea, prior to attending the Air War College. He is a graduate of the US Army Command and General Staff College where he also received a Master of Military Art and Science Degree for his thesis entitled "A Ground Commander's Guide to Close Air Support." Colonel Hayes is a graduate of the Air War College Class of 1988.

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CHAPTER I

INTRODUCTION

Of the three classical missions of tactical airpower--counter air, close air support, and interdiction--the latter is the least well-defined, most misunderstood, and generally the most unsuccessful. In spite of this, a succession of US commanders in the last three wars have chosen to allocate a large share of their available tactical airpower to the interdiction mission. In both Korea and Vietnam, about one-half of the combat sorties flown were interdictions.(1-V) Although Tactical Air Command Manual 2-1 states the purpose of interdiction is "to destroy, neutralize, confuse or delay enemy ground forces," (16:4,30) a definition of an air interdiction campaign that applied equally to Europe during World War II and the Vietnam war would be so general that it would be almost meaningless.(15:5) In each situation the enemy and friendly capabilities and objectives, as well as the physical environment of the battlefield, were so different "that it is almost impossible to articulate a universally applicable interdiction doctrine."(15:XIV) Each campaign must be specifically designed to accomplish its objectives by taking into account a multitude of interrelated factors.

The payoffs for friendly ground forces of any interdiction campaign are numerous, completely interrelated, highly situationally dependent, and have proven extremely difficult to predict. These payoffs include the destruction of both forces and supplies, the delay of forces, supply arrival or buildup, and the general disruption of military operations which in turn degrades their efficiency.(1:VI)

Most past interdiction campaigns have been characterized by disagreement between the air and ground forces as to the purpose and utility of the mission brought on to a large degree by air forces promising more than they could deliver.(15:1) This overoptimism on the part of Air Force planners was generally the result of overestimating the enemy's supply needs as well as underestimating the flexibility and adaptability of the enemy supply systems when under air attack. (1:III) These factors have combined with numerous uncertainties caused by inadequate intelligence to make a mission that looked very promising in theory a discouraging failure when tested in combat. Although several interdiction campaigns were judged successful, the results were often quite different from the original objectives.

Although the targets of past campaigns have included almost every element of military strengths,(1:10) this paper will concentrate on interdiction directed against the supply

system or force structure of enemy ground forces prior to their making contact with friendly forces. Its main purpose will be to examine this mission in an effort to identify the basic principles and planning factors that should be applied to interdiction campaigns in future conflicts. The methodology to be followed includes a review of the history of past interdiction campaigns; from this some basic fundamental and planning factors will be identified that will then be applied to current US Air Force capabilities against Soviet ground forces. The paper will conclude with recommendations for the employment of current US tactical air forces in the interdiction mission as well as acquisitions needed to enhance mission success.

CHAPTER II

HISTORY OF AIR INTERDICTION

The concept for employment of tactical airpower in the air interdiction role has been developed largely through the experiences of past conflicts. Therefore, to fully understand these concepts, it is important that we examine past air campaigns in order to gain an insight into their validity. It is not the intent of this chapter to recount a detailed chronological history of these campaigns, but instead to look at them for the purpose of validating current concepts and to identify the myriad of factors that resulted in either success or failure.

After establishing the doctrine of centralized control of airpower during the North African campaign, in early 1944, during the Italian campaign, Allied air forces found themselves in a unique position to put their new doctrine to the test of combat. When several attempts to break the German's Gustav Line failed, Allied ground commanders found themselves in a static situation and agreed to release the sorties that had been allocated to close support for an interdiction campaign. This operation was code named STRANGLE and had a primary objective of long-term supply interdiction. As a result, the Mediterranean Allied

Air Force (MAAF) issued a directive on 19 March 1944 stating that STRANGLE's objective was "to reduce the enemy's flow of supplies to a level which will make it impractical for him to maintain and operate his forces in Central Italy."(15:18)

In other words, Allied airmen proposed that airpower alone would force the Germans to withdraw from the Gustav Line. It appears that, in planning the operation, Allied planners used their own consumption rates for estimating German Army supply requirements.(15:32) Even this requirement, which was grossly overestimated, amounted to no more than 7 percent of Northern Italy's rail system throughput capacity. Therefore, in order to assure success the plan called for a 98 to 99 percent reduction in rail system capacity while damaging truck and watercraft capabilities as much as possible.(1:35) To further complicate the almost impossible task that the Allied airmen had before them, the Germans anticipated the locations of attacks and prepositioned both repair materials and crews. As a result, almost all railway system targets could be repaired within 48 hours of an attack. For instance, it took repair crews only four to six hours to repair a rail cut resulting from a bomb crater 16 feet in diameter and 5 feet deep.(15:37,10:9) Even with this massive repair effort, for a few short periods the rail system was completely blocked. However, during these periods motor

transport was used to either transship or longhaul supplies.(10:10) Even though analysis indicates that the rail system capacity was reduced an average of 95 percent, German quartermaster records show that supplies never fell below minimum requirements, and in fact the main effect on the supply system was the destruction of goods and rolling stock.(10:10, 15:33)

By April 1944, it became apparent that STRANGLE's objective was far too ambitious, and it was modified to a more realistic one of making it impossible, through supply interdiction, for the enemy to contain an Allied ground offensive.(8:5) The diversion of motor transport from the front and the disruption of the railway system did cause the breakdown of distribution systems immediately behind the front resulting in several spot shortages.(10:16) However, STRANGLE never achieved sufficient supply denial to force the enemy to withdraw even when his consumption rates were increased by an Allied ground offensive. Interdiction's real contribution was the degradation in tactical mobility of the enemy's maneuver units caused by the diversion of motor transport to the rear, in combination with the destruction of forward area bridges and roads. This degradation of tactical mobility denied German commanders the ability to concentrate their forces to either launch counterattacks or reinforce areas to prevent breakthroughs.

When units did achieve some degree of mobility, they arrived at their objective late with exhausted, underequipped (either through breakdown or attrition) troops that were short of supplies.(8:6,7,15)

When the last of Germany's strategic reserves (the Herman Goring Division) were ordered to move south and stem the Allied breakthrough at Anzio (a distance of 200-250 miles), Allied aerial reconnaissance located it on the first day of its forced day and night march. Although its personnel casualties were light, the unit arrived after four days of continuous air attack with only 11 of its 80 MK IV tanks and 70 percent of its motor transport. German commanders later admitted that the Allied Air Forces' ability to reduce and at times paralyze their freedom of movement in the battle area contributed more than any other single factor to their defeat. The German 10th Army dairy reads "Because of air attacks no timetable for arrival of units from left or right Army wing can be made."(15:VI,68,74)

In summary, the supply denial objective of STRANGLE was doomed to failure for several reasons, including: (1) the rail system couldn't be kept closed due to system redundancy and rapid repair capabilities, (2) considerable tonnage could be moved by motor and water transport, (3) German conservation measures, frugal living standards, and a

lack of ground action combined to produce very low consumption rates (considerably below the planners estimation).[10:15] Now that adequate data is available, it is obvious that the objective of the interdiction campaign should have been mobility denial. Although many of the targets would have remained the same, if the operation had been switched to the forward area, compressed into a surge operation, concentrated on lateral movement to achieve maximum mobility denial, and initiated just prior to the ground offensive, the results would have been more effective.[15:VIII, IX]

In the Normandy breakout as in Italy, the main contribution of airpower was to deny mobility to enemy maneuver units. Again, an unsuccessful attempt was made to isolate the battlefield through the destruction of the railway system; however, on 1 June 1944, after the expenditure of over 45,000 tons of bombs, the rail system was still functioning. At the same time, by D-Day with an expenditure of one-tenth the ordnance, all of the bridges along the Seine had been rendered unusable despite intensive German repair efforts.[8:10] This bridge-busting campaign, along with attacks on the Laire bridges, was a late addition to the Overload operation advocated by Allied air commanders on the basis of their experiences during operation STRANGLE. The effects of this operation were multiplied by the timing

of the operation. Since the destruction of these bridges was delayed until just before D-Day the Germans didn't have time to repair them or improvise work arounds soon enough to prevent the delay of urgently needed reinforcements attempting to counter Allied initiatives.(15:IX,9)

These delays of maneuver units were severe and widespread enough to be truly disruptive. For example, as the Ninth and Tenth SS-Panzer Divisions moved from Poland, the air interdiction campaign forced them to leave their trains at Paris and road march to Normandy. This road march of 200 miles took as long as the first 1300 miles. In addition to the delay in entering the battle, the units suffered additional wear and tear on their equipment, used additional supplies, and generally exhausted their troops.(8:11) Although several units deploying to the front lost combat capability as a result of experiences similar to those of the Ninth and Tenth SS-Panzer, most of their losses were thin-skinned vehicles while the tank forces survived relatively intact. A Royal Air Force survey of vehicles left in the Falaise Pocket in August 1944 revealed that of 40,000-45,000 motor vehicles and 800 tanks, direct air hits accounted for the loss of 9 percent of the motor vehicles, but only 2 percent of the tanks. However, congestion and fuel shortages resulting from air attack caused another 6,000-8,000 vehicles to be abandoned including most of the

tanks. Thus, even in a situation where the interdicting forces had complete air supremacy and almost unlimited sorties (5,000-10,000 sorties per day), the Allied Air Forces found it very difficult to kill armored vehicles in great numbers.(1:12)

In Normandy, as in STRANGLE, even with complete air superiority and a vigorous friendly ground offensive, interdiction had little success in isolating the battlefield through supply denial. Again, its greatest contribution to the success of the ground forces was in degrading the enemy's tactical mobility.(8:16)

The Korean War presents some very enlightening insights into air interdiction. The terrain was favorable for interdiction since at the time of the conflict both the rail and road networks were sparse and only 15 percent of the country was suitable for cross-country movement.(1:43) As the war progressed, interdiction supported both defensive and offensive as well as static action by friendly ground forces and had both force and supply interdiction as objectives. In the three years of conflict, the Air Force, Navy, and Marines flew over half of their 740,000 combat sorties in the interdiction role and delivered over 300,000 tons of ordnance while achieving some spectacular successes and some dismal failures.(1:49,54)

During the initial retreat to the Pusan perimeter, US fighter bombers were used to blunt North Korea's tank-led thrusts giving the Allied ground forces time to regroup and make a stand. This was achieved for the most part by attacking enemy maneuver units moving by road up to the line of contact. Although at the time the mission was called "close interdiction," it was basically the same as today's "battlefield air interdiction (BAI)." In September, a United Nations operations research survey located 180 tanks (over one-half of the North Korean invasion force) that were killed during this operation. Of these, 102 (57 percent) were classified as being killed by air.(1:59,60) Even though force interdiction proved very successful in this instance several specific conditions existed that contributed to the high number of armor "kills" by air: (1) the US had complete air supremacy, (2) the North Korean units had very little organic air defense, (3) the North Koreans did not expect to be interdicted by air and, therefore, had little or no training in countermeasures, (4) the lack of cross-country mobility forced the North Koreans to travel on the roads, and (5) the situation required urgent ground movement in that the North Koreans had to achieve their objectives quickly or face a rapidly increasing UN force on the ground.(1:62) These conditions allowed pilots time to locate their target and fly the

delivery pattern required to achieve the best possible weapon accuracy.

Even though the initial force interdiction campaign was very successful, the overwhelming majority of the interdiction effort went into a supply interdiction campaign designed to limit or cut off enemy supply movement. The largest of these efforts occurred during the two plus years after the Chinese intervention when the line of contact became more or less stabilized, and the UN forces were generally in a defensive posture. The objective of the operation code named STRANGLE was basically the same as its namesake that took place in Italy in 1944 and had very similarly disappointing results. It was thought that with the destruction of entire enemy supply systems, i.e.,

> route structures including rail lines, roadways, rail and road bridges; and movers including locomotives, railcars, trucks, and other vehicles (1:56)

The enemy could be forced to retreat to the north in an effort to shorten his supply lines. However, after some initial successes, the enemy's countermeasures became more and more effective and by the end of December 1951, 5th Air Force intelligence acknowledged that the enemy had

> broken our railroad blockade of Pyongyang and . . won . . . the use of key rail arteries.(1:56)

As a result, in 1952 as in the Italian campaign, the interdiction program's goal was modified to read

> interfere with and disrupt the enemy's line of communication to such an extent that he will be unable to contain a determined offensive by friendly forces or be unable to mount a sustained offensive himself. (1:57)

Although friendly ground forces never tested the enemy's ability to withstand a sustained offensive, the Communist supply system delivered his daily consumption requirements as well as built up substantial supply dumps in the forward area. The commander of the US Seventh Fleet summed up the campaign as follows:

> The interdiction program was a failure. It did not interdict. The Communist got the supplies through; and for the kind of war they were fighting, they not only kept their battleline supplied, but they had enough surplus to spare so that by the end of the war they could even launch an offensive." (1:57)

Although conditions such as friendly air superiority, large numbers of interdiction sorties available (about 9,000/month), and a limited transportation network favored successful air interdiction, several factors doomed supply denial to failure. These included (1) the enemy had a "sanctuary" area from which to supply his forces, (2) enemy consumption rates were low, especially in a static ground situation, (3) there were insufficient sorties available to achieve the required damage, (4) friendly aircraft had a limited night and no adverse weather capability to attack moving targets, (5) planners and operations officers gave insufficient attention to enemy countermeasures (such as, alternate supply routes, reduced

consumption, rapid route repair, etc.) prior to and during the campaign, and (6) the enemy reacted quickly with effective countermeasures.(1:58) The old lessons of World War II had been relearned, mainly that air interdiction alone cannot sufficiently isolate the battlefield to cause an enemy to withdraw for lack of supplies and that its effectiveness is greatly increased when it is part of a coordinated air/ground operation.

Although it is questionable whether or not even the modified objectives were achieved, airpower must be given credit for making a major contribution in persuading the enemy to sign the armistice. As Lieutenant General Nom Il later stated, "Without the support of the indiscriminate bombing and bombardment of your air and naval forces, your ground forces would have long ago been driven out of the Korean peninsula by our powerful and battle-skilled ground forces."(5:57)

In many aspects, interdiction operations during the Vietnam War faced very similar problems to those in Korea. The enemy was supplied from a sanctuary, his supply consumption rates were very low, and, for the most part, he controlled the tempo of the ground action.(5:59) Likewise, the overall military objective was very similar to Korea in that it was limited to preventing aggression. However, the objective of the interdiction campaign was quite different

in that it was less ambitious militarily and in fact appears to have been more intended for political and psychological gains. Secretary of Defense Robert McNamara outlined these objectives in Congressional testimony as follows:

> (1) To reduce the flow and/or increase the cost of infiltration of men and supplies from North Vietnam to South Vietnam;
> (2) To make clear to the North Vietnamese leadership that as long as they continued their aggression against the South, they would have to pay a price in the North;
> (3) To raise the morale of the South Vietnamese people. (17:173)

The military objective of reducing the flow of supplies (as opposed to isolating the battlefield) and increasing the cost of infiltration appears to have been a realistic and attainable goal. The diverse road networks in the area, and an immense labor force combined to limit the closure of most major roads to only a day and in several cases a matter of hours after an attack.(17:190) Although this campaign disrupted/delayed supplies and, as General Momyer (Commander, 7AF in Vietnam Jul 66 to Aug 68) contends, prevented the North Vietnamese from deploying or logistically supporting their full 18 to 20 divisions, the real value appears to have been the "penalty" or cost it imposed on the North Vietnamese and their suppliers.(17:175, 1:15)

In addition to the economic cost of replacing vehicles and supplies, the campaign reduced available enemy manpower as the North Vietnamese devoted a labor force of

between 300,000 and 500,000 troops and civilian militia to repair the transportation network and an additional 175,000 to man the air defense system.(17:190) Although some improvement was made in munitions effectiveness with the addition of precision-guided munitions (PGM), the military results of the supply interdiction campaign were very similar to previous wars. The enemy decided to "pay the extra price" and reduced his consumption rates, added extra manpower for transportation network repair, and introduced enough quantity at the beginning of the supply system to insure, even after attrition, that sufficient supplies reached the front line.

Although World War II, Korea and Vietnam established some valuable principles of interdiction, our first chance to examine the effects of airpower against highly mechanized and armored maneuver forces were the 1967 and 1973 Arab-Israeli Wars. After the quick and total defeat of the Arab Air Forces, in the 1967 war, the Israeli Air Force turned its entire attention to the support of ground forces. Although no coordinated campaign ever developed, the Israeli Air Force did a great deal of damage to the Egyptians' armor as it retreated across the Sinai toward the Suez Canal. In the aftermath of this operation, Israeli researchers determined that of 527 Egyptian armored vehicles they examined, 195 (37%) were killed by ground-

based systems, 80 (15%) were killed by air, 203 (39%) were abandoned, and 49 (9%) were unexplained. It is interesting to note that, as the attrition rate from air increased from 7.5% in the north (that was accessible to ground forces) to 26.97% in the southern region (where air attack was more intense) , a corresponding increase occurred in the abandon rate, from 24% to 60%.[23:108] Several factors or a combination of factors could account for this increase to include a breakdown of command and control, disruption of the supply system, or simply a dramatic lowering of morale during intense air attacks.

During the 1973 war, the Israeli Air Force combined with a weak ground covering force in an attempt to hold the attacking Arab armor until reinforcements could be moved forward.[3:11,9]. In this situation, the Arab Air Force had an ideal situation to interdict (and chose not to execute it) the Israeli reinforcement because: (1) Israeli reinforcement had an urgent requirement for movement and (2) the target array would have been largely under the influence of their own surface to air missile systems.[5:66] On the other hand, the Israeli Air Force attempted to attack the Egyptian ground forces despite the formidable air defense network and suffered a very severe loss rate (10-14% initially and 8% later) while inflicting very little damage. However, after the Egyptian armored units moved out from

under their SAM umbrella, the IAF inflicted heavy losses and, in fact, stopped the Egyptians' armored advance without the loss of a single aircraft.(23:113) From the Arab experiences in the 1973 war, it appears that in modern maneuver warfare, air superiority is a must for airpower to successfully conduct a force attrition campaign however:

> Airpower, using improved conventional munitions and precision guided missiles, can now dominate the battlefield and provide an effective antidote to rampaging armor as long as air superiority can be retained. (23:113)

It should be noted that air superiority in this context means superiority over both air-to-air and ground-to-air systems. After the 1973 war, the IAF determined that the time to attack ground forces with air is prior to their deployment for contact because: (1) close support attrition rates are unacceptably high unless the ground to air defenses are suppressed, and (2) after deployment targets are harder to find and attack.(4:54)

In summary, since World War II, air interdiction's general objective has been to enhance friendly ground operations by either denying or restricting the enemy's ability to conduct either offensive or defensive actions. Two basic strategies have been applied in pursuit of this objective, either supply or force denial. Although supply denial campaigns have been the most common, they almost always failed to achieve their initial objectives. Several factors contributed to these failures, but they were all

basically the result of an overoptimistic expectation of airpower's capability combined with a grossly inaccurate assessment of the enemy's supply requirements and the factors that affected his ability to fulfill those requirements. As a result, supply denial campaign plans were little more than wishful thinking. Force denial on the other hand has met with considerable success and, in fact, in some cases the main contributions of a supply denial campaign were the resulting collateral force denial effects. It appears that force denial can be logically divided into either force attrition or mobility denial. Although force attrition is the most positive method of degrading an enemy's ability in today's high threat environment, it is also the most expensive in terms of sortie requirements and aircraft attrition rates. On the other hand, mobility denial is a proven method of degrading an enemy's combat capability at a reduced cost. However, it has only been effective against mechanized units with time urgent movement requirements.

CHAPTER III

THEORY OF AIR INTERDICTION

Interdiction payoffs in pursuit of its overall objective of degrading the enemy's capability to conduct ground combat operations come in the form of destruction, delay, diversion, or disruption. Destruction includes the attrition of maneuver forces, support elements, and supplies. Delay usually results from the destruction or denial of route structure used to supply the front line or tactically move maneuvers units. This results in the prevention or late arrival of supplies or maneuver units and a commensurate inability to build up combat strength at the time and place required. Diversion refers to the reallocation of either combat or logistic assets to counter the effects of interdiction. These assets could be reassigned to such tasks as repair of damaged route structures, building bypasses, or manning air defense systems. The fourth payoff, disruption, although difficult to quantify, but generally refers to the degradation of an enemy's ability to coordinate mutually supporting activities of either his maneuver forces or supply system as a result of attacks on his command and control system. All four of these payoffs are overlapping and mutually reinforcing, thus creating a synergistic effect that, while difficult to

quantify, results in a fifth and maybe the most significant payoff which is a dramatic increase in the enemy commander's uncertainty during the planning process.(1:3)

As chapter two's brief accounting of interdiction history illustrated, an enemy became more vulnerable to these interdictions payoffs as: (1) his requirement for the timely arrival of forces or supplies became more urgent, (2) his forces became more mechanized, thus requiring more supplies and route structure, and (3) the distance from his supply source to the line of contact increased.(1:30) The two strategies that have developed in an effort to exploit these payoffs are supply and force denial.

Supply denial interdiction campaigns are intended to delay the buildup of supplies at the front line and are normally directed against the route structure used to transport the supplies, however, they might be directed against the transportation vehicles, the supplies themselves, or some combination of the three. The effectiveness of these campaigns can be measured in several ways to include: (1) a quantifiable reduction in throughput over a given time, i.e., numbers of vehicles or tons of supplies that arrived at the destination per day, (2) the delay in transit time from the source of supply to destination, (3) quantities of supplies or number of

vehicles damaged or destroyed, or (4) quantity of enemy resources (both manpower and material) diverted or consumed to sustain movement or prevent loss.(1:18) The optimum situation for a supply denial campaign occurs when the enemy is consuming large quantities of a specialized item that is vulnerable to air attacks and must be supplied by a long and vulnerable supply line with no alternate routes.(15:11) As any one of these factors move away from this optimum situation (lower consumption, alternate source for item, shorter supply line, etc.) the task of conducting a successful supply denial campaign becomes more difficult. In any event, success will require a continuous (to include night and bad weather) application of large numbers of sorties over an extended period of time. This implies the ability to generate high sorties rates from secure bases near the target (or the commitment of a large air refueling force) and very low sortie attrition rates.(1:37)

After determining that the enemy is vulnerable to supply denial and we have the ability to carry out an interdiction campaign, we must decide on what is to be targeted (vehicles, supplies, route structure, or a combination of these).(1:20) Attacking either the supplies or the vehicles is a fairly straightforward process of locating the targets and then targeting them. However, most uninterdicted route structures are capable of

throughputting many times the supplies required by the enemy. This requires the careful selection of targets that are relatively easy to cut, have no or few bypasses, and are difficult to repair.(1:33) Bridges have always been a favorite route structure target because they are easy to identify from the air, difficult to bypass or repair, and create natural choke points.(1:13) With the advent of modern precision guided munitions (PGMs), they become even more attractive targets along with landslide areas, tunnels, and transshipment points.

The normal approach in planning a supply denial campaign has been to model the route network and determine throughput capacity. That capacity is then compared to enemy supply requirements and a strategy is developed (either by attacking route structure, vehicles in route, depots or some combination) to reduce the throughput capacity below requirements.(1:18) In addition to the obvious answer of decreasing throughput by use of airpower, coordinated action by ground forces can increase consumption rate thereby raising the supply requirements and contributing to the differential between throughput capacity and requirements. Although the process seems fairly simple in theory, the results have been discouraging when applied to combat situations. Among the uncertainties that contributed to problems are:

(1) What is the enemy mode of operations? Convoys? Unit sizes? Intervehicular and interunit distances? Straight-through movement shuttle chains with inter-shuttle transshipment? Speed? Day vs night movement? Hours of operation per day? Surge mode and capacity?
(2) In general, how will different means of transport interact and reinforce each other? Air, rail, road (both wheeled and tracked vehicles), and portage? In particular, how will airlift, including helicopter short-haul transshipment, be used to overcome delay or stoppage?
(3) To what extent is unprepared off-route movement possible? For tracked vehicles, for wheeled vehicles? Sensitivity to weather and seasons?
(4) What are repair times for damaged route structure of various types? (Note that average repair times may be quite misleading because they usually included both urgent and nonurgent repairs--and are usually based on imperfect intelligence.)
(5) Are local bypasses available? Can they be quickly constructed? What delays and constraints on types of traffic do they impose? Weight of vehicle? Tracked only? Sensitivity to weather and seasons?
(6) How does uncertain damage, e.g., a 0.8 probability of dropping a bridge span, affect movement and throughput over time in a route network? Expected value calculations with average repair time and movement rates are clearly inappropriate when enemy forces can leak and surge through the undamaged link.
(7) Given uncertainty about route structure, damage repair time, and surge capabilities, how frequently should attacks occur? What is the requirement for reconnaissance for damage assessment? What is the requirement for quick reaction attacks, e.g., while enemy forces are surging across a newly repaired bridge?(1:19)

With all of these uncertainties, it is little wonder that even with the enormous number of sorties available and almost total air superiority, we have never been able to successfully "isolate the battlefield" through the use of air power.(8:16) However, we generally produced a

disruption of enemy's normal operations procedures and support services that in effect degraded his combat capability.(15:XI)

The difficulties encountered in successfully executing a supply denial campaign make interdiction attacks against maneuver units or force denial particularly attractive since a short term commitment can result in an immediate and, at times, very high payoff.(1:14) The highest payoffs (i.e., the safest way to ensure the enemy is beaten) naturally occur when the enemy's maneuver forces are actually attrited.(21:5) In addition, this demonstrated ability to attrit maneuver forces often causes the enemy to delay and divert resources.(1:4) Although force attrition offers the most positive and least situational dependent payoffs, it may be the most difficult to achieve since maneuver forces must be: (1) Found--this requires real time or near real time, day, night, and weather recce capability, (2) Prioritized--we must be able to select and kill the targets with the "highest payoff" (i.e., command and control vehicles, tanks, AAA, etc), and (3) Successfully attacked--this usually requires an anti-armor munition that is capable of being delivered in day, night, or weather and is either precision guided or delivered by extremely accurate aircraft.(18:51) Maneuver units are most vulnerable to this type of interdiction when they are moving in a road march

formation because: (1) They are easier to find (although the time sensitivity of the information becomes more critical), (2) Prioritization becomes easier due to doctrinal positioning in the road march formation and a lack of camouflage, and (3) Air defenses are less effective, thereby decreasing sortie attrition and increasing weapons delivery accuracy.

Although force attrition has some definite advantages (i.e., the positive elimination of the threat), current system's capabilities make successful execution questionable. Deficiencies include the lack of: (1) real time, accurate intelligence data required to locate and distinguish the desired targets, (2) aircraft reaction times and force flexibility required to respond to fast moving target arrays, (3) munitions that have a high probability of achieving multiple armor kills on a single pass, and (4) the aircraft survivability required to seek out and destroy multiple moving targets in a high threat air defense environment. Therefore, force (maneuver unit) mobility denial, although not as positive, has several attractive aspects.

The delay of maneuver forces or mobility denial has a definite detrimental effect on armies in the conduct of land warfare. However, this effect is very difficult to analyze and qualify (particularly at the time of the

action).[15:62] In addition to the direct effects of mobility denial on the enemy's tactical operation, it enhances both supply denial and force attrition campaigns. The force attrition is enhanced by increasing the time maneuver units are "at risk" to air attack as well as creating more concentrated target arrays by bunching up vehicles at interdicted choke points. Supply denial is similarly enhanced as resources such as engineering, air defense, and manpower are diverted from the supply system in attempts to avoid delay in the movement of maneuver units.[1:7]

Mobility denial is in actuality a delaying action since total immobilization of ground maneuver units is realistically almost impossible to accomplish and maintain over an extended period of time. Although normally the longer a maneuver unit can be delayed the better, total immobilization is, in fact, not necessary to achieve a high payoff from mobility denial actions. For example, to be effective, required forces must arrive within a certain time. If they can be delayed long enough to arrive outside that critical time period, their benefit to the enemy is decreased or completely eliminated. On the other hand, interdiction efforts that further delay (beyond the critical period) the forces or allow them to arrive within the

critical time period (even though delayed) have very little payoff.(1:5)

Large scale maneuver units have a limited capability to conduct rapid cross country off-road movements, either due to equipment or terrain limitations. When this, combined with the fact that they require as much as six to eight times the road capacity of their resupply efforts, it becomes evident that the capacity of the road network is the major factor in determining the speed with which maneuver forces can be moved.(2:99, 15:62) As a result, a large number of transportation junctions or nodes and choke points become available as targets for mobility denial of enemy ground forces.(2:192)

Although the target array that produces the delay is fairly easy to define, the requirement for time-urgent movement which, in turn, creates a shorter critical time period is usually required to produce major payoffs. These time-urgent movements result when the enemy: (1) tries to take advantage of surprise, (2) needs to quickly defeat ground forces and seize territory before reinforcements arrive, (3) requires rapid reinforcement of his threatened defensive position, or (4) wishes to exploit the success of his offensive operation.(1:6) In all of these conditions, the "enemy has a strong incentive to reach specific objectives within time constraints."(1:30) It is,

therefore, to the interdictor's advantage if he can control both the constraints and incentives thus forcing the enemy into time-urgent movement at a time and place of the friendly force's choosing. The ability to control his action provides an opportunity to reap the "synergistic benefits of coordinated air-ground planning, preparation and execution."(1:6)

Since the effects of mobility denial are temporary, it must (1) be timed to deny the enemy mobility just when he needs it the most (not allowing time for work arounds or repair) and (2) be coordinated with ground forces so they can take full advantage of the situation in the time provided.(15:X1) Without both of these actions occurring, the enemy has the option to either shift or expand his time scale and thus almost totally negate the effects of the delay.

Although all three types of interdiction, (supply denial, force attrition, and force mobility denial) can be effective under certain conditions, the damage done is usually repairable, temporary, and, if given enough time, has little operational significance. Therefore, generally speaking, the closer to the front line that interdiction can be efficiently conducted the more immediate and productive it will be. For example:

> . . . on the battlefield, a mobility kill may be fatal, where at 75 km in the enemy rear it can be repaired.(7:879)

Likewise, a delay of two hours on a unit that is four hours from its object is far more serious than a delay of two hours on a unit that is four days from its objective.

Although air interdiction can be a very effective use of tactical airpower, it must be pointed out that if an enemy chooses to, he can counter its effects by: (1) committing extra resources (air defense, engineers, supplies, maneuver units, etc.) to critical operations he feels will be interdicted, (2) "bulling" through and maintaining his speed and timing, but pay a heavier price in attrition, or (3) accept some delay by moving at night or using alternate routes, thereby reducing both attrition and the diversion of resources.(1:4)

Another factor in the outcome of interdiction campaigns has been each side's learning curve. Since the interdicted side is the one that is being hurt and also has the most current and complete assessment of the results, it is only logical that his learning curve is much steeper than that of the interdictor.(1:24) Therefore, a good interdiction planner will anticipate enemy reactions and assess success in terms of what cost each reaction imposes on the enemy as well as himself.(1:VI)

CHAPTER IV

CURRENT SITUATION

Since our most dangerous threat is the Soviet Union, its forces and military doctrine are a good example to use in applying history lessons and the general theory of air interdiction. In recent years, the Soviet forces, along with their Warsaw Pact Allies, have emphasized both mass and momentum to develop a highly effective warfighting concept of operation.(6:9) The execution of this concept is extremely complex and requires extensive planning and closely coordinated combined arms operations to achieve the required mass at critical points while maintaining the maximum momentum of the overall operation.(20:543, 21:7)

The Soviets plan their rate of advance in Europe to be between 30 and 50 km per day. No delay in their rate would be acceptable as the loss of momentum would (1) tend to concentrate follow-on forces and make them a lucrative target for air attack, (2) weaken an already politically strained Warsaw Pact alliance, and (3) increase the possibility of escalating the conflict to the strategic nuclear levels.(13:33, 6:9) As a result, they have created for themselves one of the primary requirements for a successful force denial air interdiction campaign--that being the <u>time-urgent</u> movement of maneuver forces.

Although their tactical doctrine places maneuver forces in a position vulnerable to air interdiction, Soviet logistic doctrine is quite the opposite. Soviet divisions are supplied according to a prioritized need established at front level. This centralized control promotes economy, increases flexibility, and ensures that sufficient assets are committed to supply the highest priority maneuver units--those that are successful. In addition, a similar centralized battle damage repair operation prioritizes repair of the least damaged equipment in order to ensure its rapid return to service (in WWII 60-70 percent of Soviet equipment was returned to service in one or two days).(13:36, 37) Although air attacks may create disruption and delays, a system such as this, when combined with the prospect of a short war, make supply denial an unattractive option for air interdiction.

One of the primary ingredients to their overall plan (and, therefore, something we must stop) is the Operational Maneuver Group or OMG. An OMG's function is to cause the defense to completely collapse by rapidly exploiting a penetration of the front line.(20:542) This concept may reduce the need to concentrate forces for a breakthrough by advancing on multiple axis with dispersed formations seeking a weak point in the defense. When a weak point is found, it will be penetrated quickly by the leading elements and be

exploited by committing an OMG to objectives in the rear area.(7:876, 11:8) Since the OMG has organic supplies to last at least a few days (their mission would be complete), the only option available for air interdiction to counter this threat is force attrition or mobility denial.(13:36)

Since timing is absolutely critical to the success of the OMG, disruption and slowing of its time schedule may be the Achilles' heel of the entire concept. However, the Soviets are well aware that we will consider the OMG a high priority target and believe that our airpower can react decisively against it, therefore, they are planning accordingly.(13:35, 36; 20:544)

In fact, the Soviets' thoroughness for planning may make any form of interdiction difficult. Since the majority of Soviet vehicles are wheeled and thus require a relatively sophisticated road network. Their planning system focuses in detail on the ability of the road network to support the movement of maneuver units. Characteristics specifically addressed include: (1) the length, (2) surface condition and load-bearing strengths, (3) minimum width for each segment to include both the surface and the shoulders, (4) alignment, degree of gradients, radius of turn, etc., and (5) safe speed for each type of vehicle in the operation. Their study is then used to determine the type of unit that can transit each segment as well as the time required for

that movement. A detailed analysis is then made of interdiction effects on the operation, and a strategy is developed to counter those effects. Elements of their strategy include: (1) road networks to be used, (2) cross-country mobility (attention to bypass opportunities and general off-road movement to facilitate rapid advance), (3) force in terms of numbers (length, resupply demands), (4) composition and movement doctrine (type of vehicles, variable speed capabilities, spacing, overall movement speed, and air defenses), (5) ground resistance (manmade and natural obstacles, repairs, engagements), and (6) air interdiction (increased dispersion, creation of obstacles and chokepoints, route structure repairs). (2:53, 54, 99, 173)

With this degree of detailed planning, Soviet countermeasures to any form of air interdiction may be very effective. These could include: (1) sufficient assets to overcome attrition, (2) prepositioning of repair crews and equipment, (3) electronic combat and direct attack to disrupt or destroy command and control, (4) extensive camouflage concealment and deception efforts to include large amounts of radar reflectors and smoke, and (5) an integrated air defense system that may represent the most effective countermeasure.(22:102) In fact, all Soviet divisions have both a better quantity and quality of mobile

air defense system than has ever been encountered in combat.[6:10] For example, a typical Motorized Rifle Division has 20 SA-6 launchers (60 missiles), about 150 SA-7s, 24 S-60 guns, and at least 16 ZSU 23/4s.[13:35]

In order to stop a Soviet ground offensive, his momentum must be interrupted. Since momentum consists of both mass and movement, the destruction of either will effectively stop the Soviet momentum. If mass is to be targeted, we must actually kill his vehicles (i.e., force attrition).[21:5] In this context, it has been estimated that 60 percent of a Soviet division's troops and equipment must be destroyed to cripple its combat efficiency. With today's capability, this requires 2200 sorties using general purpose bombs and about 220 sorties using CBU type munitions such as Rockeye.[3:134] Even using an optimistic attrition rate of 5 percent (remember the Israelis had between 10 and 14 percent), we would attrit between 11 and 110 aircraft per division. Obviously, using these munitions, we would run out of aircraft long before the Soviets ran out of ground forces.

If, on the other hand, we decide to interrupt the Soviet momentum by stopping or delaying their movement, we have the choice of a supply denial or a mobility denial campaign. Even though a Warsaw Pact MRD requires about 1000 tons of fuel and ammo daily, the Soviets' logistical system,

combined with their willingness to plan for and accept attrition in order to sustain movement, makes supply denial an unattractive option.(21:6, 3:124) Thus mobility denial of maneuver forces appear to be our only effective option given today's capabilities. The Soviets have repeatedly stressed the fact that any delay in the movement of their maneuver units would severely degrade their effectiveness. Soviet Troop General Dimities Deagunsky noted in 1983 that:

> One of the decisive conditions for a swift and continuous offensive in the skillful and timely concentration of efforts on the axis of the intended success."(21:5)

Therefore, to be successful, given today's capabilities, our interdiction campaign must concentrate on delaying and disrupting the movement of key units in key areas to prevent the concentration of cohesive units required for a breakthrough or the speed required to exploit a breakthrough if one occurs.(22:104) Once a maneuver unit is delayed, friendly ground forces have time to position reinforcements while taking on the enemy in more manageable bits. In addition, while the enemy maneuver unit is delayed, it presents a much more lucrative force attrition target.

CHAPTER V

CONCLUSIONS

Since the utility of air interdiction is highly scenario dependent, each campaign must have a specific strategy designed to accomplish well defined and realistic objectives.[1:8] This overall strategy can be either supply or force denial and will normally increase in effectiveness in direct proportion to the amount air/ground coordination employed in its planning and execution.

Even though air interdiction has accounted for a large portion of the United States' tactical air effort in its last three major conflicts, in general the results fell far short of what planners had envisioned. Numerous factors contributed to these disappointing results, however, the major cause was poor campaign planning that produced unrealistically high expectations.

Air interdiction campaign plans were characterized by a failure: (1) to understand the basics of interdiction theory (i.e., what payoffs were possible and which strategy was most appropriate), (2) to obtain good intelligence data on the enemy's vulnerabilities, requirements, capabilities, and employment doctrine, (3) to appreciate the highly interactive nature of air interdiction (i.e., measure, countermeasure) where success depends on quick learning and

a steady flow of timely intelligence[1:VI], (4) to appreciate the effects of operational constraints imposed by political authorities (i.e., sanctuaries, bombing halts, target restrictions, etc.), (5) to integrate air and ground actions and, therefore, take full advantage of the synergistic effects of mutually supportive air/ground operations, (6) consider intangible factors such as uncertainty, surprize, training, tactics, adaptability, and national characteristics[7:876], and (7) fully appreciate operational factors effecting the interdiction force (i.e., munitions capabilities, night/WX capabilities, air defense, etc.)

On the other hand, future planners can take advantage of axioms developed from past campaigns and proven air interdiction theory. These axioms include: (1) supply denial campaigns require a long time to take effect, (2) force denial campaigns have a near term, immediate effect on the ground situation, (3) air superiority is a prerequisite for a successful supply denial or force attrition campaign, using current weapons systems, (4) supply denial, using current weapons systems cannot "isolate" the battlefield, (5) the majority of payoff in past air interdiction campaigns was the result of force denial, (6) interdiction has a greater impact when the enemy has time-urgent requirements, and (7) almost all interdiction campaigns can

be countered if the enemy chooses to devote the required resources to countermeasures.

Although our most productive strategy today appears to be force maneuverability denial, we need to improve our capability to execute this strategy while acquiring the ability to execute other options (i.e. supply denial or force attrition). New equipment acquisition should focus on: (1) a real-time reconnaissance capability aimed at rapidly reacting to enemy countermeasures and target damage assessment. The objective being to at least keep up with or surpass the enemies learning curve, (2) the ability to accomplish the mission at an acceptable attrition rate without first achieving air superiority. This should be approached from both improving the effectiveness of our supression of enemy air defense (SEAD) and increasing our kill per sortie. In this regard, the kills per sortie are generic in that although we need to kill multiple armored vehicles per sortie (force attrition), we also need improved area denial munitions (mobility denial), (3) the capability to operate effectively at night or in the weather, and (4) a command and control system that is capable of rapidly reacting to the information obtained by the reconnaissance system recommended in (1) above.

To get the best results out of this equipment and knowledge we must develop joint interdiction doctrine and

train both our air and ground commanders in its application. Only well-trained commanders following a common doctrine can properly plan a coordinated campaign and quickly adjust its execution to the highly dynamic situations encountered on a modern battlefield.

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